REMARKS

In view of the following remarks and the foregoing amendments, reconsideration and allowance are respectfully requested.

Claims 1-4, 6-11, 13, 14, 32 and 33 are pending at the time of this action, with Claims 1, 9, 13, and 32 being independent. Claims 34-40 are currently added. Therefore, Claims 1-4, 6-11, 13, 14, 32-40 are currently pending.

Claims 1-4, 6-11, 13, 14, 32 and 33 stand rejected. Claims 5 and 12 stand objected to.

Claims 1, 2 and 7 stand rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Sambucetti in view of Lee. This contention is respectfully traversed.

Claims 1, 3 and 8-10 stand rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Lee and Tong. This contention is respectfully traversed.

Claims 4 and 11 stand rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Hongo and Lee. This contention is respectfully traversed.

Claim 6 stands rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Sambucetti and Lee in view of Tong. This contention is respectfully traversed.

Claim 14 stands rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Tong and Lee as applied to Claim 9, and further in view of Sambucetti. This contention is respectfully traversed.

Claims 32 and 33 stand rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over Tong and Lee in view of Kazama. This contention is respectfully traversed.

Claims 5 and 12 stand objected to but are allowable if rewritten in independent form to include all of the features of the base claim and any intervening claims. Therefore, Claims 5 and 12 are currently amended to include the features of the base claim and intervening claims to place Claims 5 and 12 in condition for allowance.

35 U.S.C. 103 – Claims 1, 2, 7

Claim 1 is patentable over the suggested combination of Sambucetti and Lee at least because these references fail to teach or suggest every feature of the claim. For example, the suggested combination fails to teach or suggest the Claim 1 features of "wherein the diffusion barrier is configured to prevent Cu and Sn from diffusing through the diffusion barrier and to prevent CuSn intermetallic formation in the apparatus."

Sambucetti shows a method for preparing a conductive pad for electrical connection (Sambucetti: Abstract). Sambucetti discloses a structure, as shown in Fig. 2, where the first diffusion barrier 16 includes a metal alloy material such as phosphorus or boron (Sambucetti: Col. 5, lines 61-67; Col. 6, lines 1-2). Thus, Sambucetti does not disclose that the diffusion barrier includes both a phosphorus and a boron-containing metal alloy, as in Claim 1. Furthermore, Sambucetti fails to disclose anything about CuSn intermetallic formation in Col. 1, lines 39-41. Instead, Sambucetti discloses "the common usage of a diffusion barrier formed of TiN for preventing aluminum diffusion into underlying conductive layers" (emphasis added). Since Sambucetti discloses a diffusion barrier of phosphorus or boron rather than a phosphorus and a boron-containing metal alloy, Sambucetti fails to teach or suggest all of the features of the claim, including providing a teaching of what type of diffusion barrier could block Cu and Sn diffusion, as well as preventing CuSn intermetallic formation. So, the office action attempts to use Lee in the suggested combination to remedy all of the deficiencies of Sambucetti.

Lee teaches a thin film structure that includes a barrier layer over an insulating layer (Lee: Abstract, paragraph 35). Lee teaches that the barrier layer includes titanium, P, and B to "impede diffusion from subsequently-formed copper-based layers into insulative material 54" (Lee: page 3, paragraph 35). Lee also teaches that "in some applications, layer 58 can be a barrier for inhibiting or preventing diffusion from a metallic material to a non-metallic material," and "in an exemplary process, layer 58 is a barrier layer for preventing diffusion from a conductive copper based material to insulative material 54" (Lee: page 3, paragraph 38). Thus, Lee fails to remedy the deficiencies of Sambucetti for several reasons.

For example, Lee teaches that the diffusion barrier prevents diffusion from a copper-based material to an insulative material. In particular, Lee teaches that some material from copper-based layers are blocked in general. However, Lee specifically fails to teach that Sn is blocked. Hence, Claim 1 is patentable over the suggested combination for this reason alone.

Furthermore, like Sambucetti, Lee is also silent on teaching preventing CuSn intermetallic formation as recited in the claims. Therefore, Claim 1 is patentable over the suggested combination for this additional reason.

Not only is Lee silent on teaching preventing CuSn intermetallic formation, Lee teaches that the purpose of the barrier layer is for preventing metallic material from reaching the non-metallic material (i.e., the insulating layer 54). The focus of Lee's teaching is on protecting an insulating layer, and not a conductive layer below the barrier layer. Because Lee fails to teach a conducting layer below the diffusion barrier layer, Lee could not teach preventing CuSn intermetallic formation, which is a conductive feature with two specific metals. Hence, Claim 1 is further patentable over the suggested combination for these reasons, and should be placed in condition for allowance.

Claims 2 and 7 depend upon base Claim 1, and are patentable for all of the reasons above with respect to base Claim 1.

35 U.S.C. 103 – Claims 1, 3, 8-10

Claims 1, 3, 8-10 are patentable over the suggested combination of Lee and Tong at least because these references fail to teach or suggest every feature of the claim. For example, the suggested combination fails to teach or suggest the Claim 1 features of "wherein the diffusion barrier is configured to prevent Cu and Sn from diffusing through the diffusion barrier and to prevent CuSn intermetallic formation in the apparatus." Lee fails to teach these claim features for all of the reasons above. Tong fails to remedy the deficiencies of Lee in the suggested combination.

Tong teaches a method of forming bumps on the active surface of a silicon wafer, in which an under-ball metallic layer serves as a barrier blocking the diffusion of metallic particles into the insulation layer inside the wafer (Tong: Abstract; Col. 6, lines 43-46). However, Tong fails to disclose the feature in Claim 1 of "a diffusion barrier in contact with the first conducting layer, wherein the diffusion barrier comprises a metal alloy comprising boron and phosphorus." Instead, Tong discloses that "the barrier layer 330 is made from a material such as nickel-vanadium alloy, chromium-copper alloy or nickel" (Col. 4, lines 2-4). In another embodiment, Tong discloses that the under-ball metallic layer in Fig. 6 can have two, three, or four layers (Col. 6, lines 5-15). However, Tong fails to disclose that any of those layers include a diffusion barrier with "a metal alloy comprising boron and phosphorus," as recited in Claim 1 (emphasis added). As a result, Tong fails to teach a composition of a diffusion barrier layer that has the properties to "prevent Cu and Sn from diffusing through the diffusion barrier" as recited in Claim 1 (emphasis added). Since Tong fails to even teach a diffusion barrier layer that has the

properties to "prevent Cu and Sn from diffusing through the diffusion barrier," Tong also fails to teach that the diffusion barrier layer prevents "CuSn intermetallic formation in the apparatus." Thus, Claim 1 is patentable over the suggested combination for these reasons alone.

Moreover, the office action only generally points to a teaching of where Tong teaches diffusion blocking (Office action points to Col. 6, lines 43-46 of Tong). However, Col. 6, lines 43-46 of Tong teaches blocking metallic particles from entering an insulating layer, not another metallic layer – so there is not a teaching of "intermetallic formation." Furthermore, the office action fails to show where Tong specifically teaches preventing "intermetallic formation" for a CuSn intermetallic. Since the burden to establish obviousness has not been met, Tong fails to remedy the deficiencies of Lee, and the suggested combination fails to render Claim 1 obvious.

Claims 3 and 8 are patentable at least for depending on an allowable base claim, base Claim 1. Claim 9 recites features similar to Claim 1 and is patentable for at least the same reasons as Claim 1 above. Claim 10 is patentable at least for depending upon an allowable base claim, Claim 9.

35 U.S.C. 103 – Claims 4 and 11

Dependent Claims 4 and 11 are patentable over the suggested combination of Lee, Tong, and Hongo at least because these references fail to teach or suggest every feature of the claim. Claim 4 is patentable for being based upon an allowable base claim, base Claim 1. Claim 11 is patentable for being based upon an allowable base claim, base Claim 9, which has features similar to Claim 1 as described above. For example, the suggested combination fails to teach or suggest the Claim 1 features of "wherein the diffusion barrier is configured to prevent Cu and Sn from diffusing through the diffusion barrier and to prevent CuSn intermetallic formation in the apparatus." Lee and Tong fail to teach this claim feature for all of the reasons above. Hongo fails to remedy the deficiencies of Lee in the suggested combination. For example, Hongo teaches an electroless plating apparatus that has a seed layer that includes Co (Hongo: Abstract, paragraph 049). Hongo is silent about teaching or suggesting the claim features as described above with respect to Claim 1. Furthermore, the office action does not show where or how Hongo would teach or suggest the recited features of Claim 1 to establish obviousness. Therefore, Claims 4 and 11 are patentable over the suggested combination for these reasons.

35 U.S.C. 103 – Claim 6

Dependent Claim 6 is patentable over the suggested combination of Sambucetti, Lee, and Tong at least because these references as a whole fail to teach or suggest every feature of the claim. For example, the suggested combination fails to teach or suggest the Claim 1 features of "wherein the diffusion barrier is configured to prevent Cu and Sn from diffusing through the diffusion barrier and to prevent CuSn intermetallic formation in the apparatus." Since Claim 6 depends upon an allowable base claim as described above for the suggested combination, the rejection under 35 U.S.C. 103 should be withdrawn and Claim 6 should be placed in condition for allowance.

35 U.S.C. 103 – Claim 14

Dependent Claim 14 is patentable over the suggested combination of Sambucetti, Lee, and Tong at least because these references as a whole fail to teach or suggest every feature of the claim. Claim 14 depends upon an allowable base claim, base Claim 9, which has features similar to Claim 1. For example, the suggested combination fails to teach or suggest the Claim 1 features of "wherein the diffusion barrier is configured to prevent Cu and Sn from diffusing through the diffusion barrier and to prevent CuSn intermetallic formation in the apparatus." Since Claim 14 depends upon an allowable base claim as described above for the suggested combination, the rejection under 35 U.S.C. 103 should be withdrawn and Claim 14 should be placed in condition for allowance.

35 U.S.C. 103 - Claims 32-33

Claims 32-33 are patentable at least for the same reasons as described above with respect to Claim 1. Neither Tong, Lee, nor Kazama, alone or in combination, teaches or suggests all of the features as arranged in the claims. Kazama, in showing a circuit board (10) with a circuit for routing a signal, fails to remedy the deficiencies of Tong and Lee for all of the reasons above (Kazama: Abstract; Fig. 5). The Applicants respectfully request that the rejection to Claim 32 under 35 U.S.C. 103 be withdrawn, and that Claim 32 be allowed.

Claim 33 is patentable for depending on an allowable base claim, Claim 32. Allowance of Claim 33 is respectfully requested.

Newly Added Claims - Claims 34-40

Claims 34-40 are newly added claims that depend upon an allowable base claim (Base Claim 5 for Claims 34-37; Base Claim 12 for Claim 38). Claims 34-40 do not add new matter. For example, Claims 34-38 recite features similar to currently pending Claims 2-3, 6-7, and 10, and Claims 39-40 include allowable subject matter as recited in the amended Claim 5. Therefore, allowance of these claims is respectfully requested.

CONCLUSION

In view of the amendments and remarks herein, the Applicants believe that Claims 1-4, 5, 6-11, 12-14, 32-40 are in condition for allowance and ask that these pending claims be allowed. The foregoing comments made with respect to the positions taken by the Examiner are not to be construed as acquiescence with other positions of the Examiner that have not been explicitly contested. According, the arguments for patentability of a claim should not be construed as implying that there are not other valid reasons for patentability of that claim or other claims.

Please apply charges for the excess claims fee and any other charges or credits to deposit account 06-1050.

Respectfully submitted,

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